Sr-isotope composition as a tracer for source identification of long-range transported Asian dust

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Introduction

Sr-isotope is one of the most useful geochemical tracers for the long-range transported terrestrial materials. In spite of its great possibility, it has not been successfully used for the source identification of Asian dust in the present time. In this study, we present the Sr isotope composition as well as the major and trace element composition, of the bulk aerosols and snow-trapped Asian dust particles collected over Japan in 2000 and 2001, and try to identify the source of long-range transported Asian dust.

Result and Discussion

The Sr isotope ratios ($^{87}Sr/^{86}Sr$) of the aerosol collected over Japan during spring were obviously higher than those of local possible source components. This suggests that Japanese aerosols in spring are considerably affected by long-range transported Asian dust of which Sr isotope ratios are higher than original surface soil in Japan. The potential sources of Asian dust are considered to be fine soil particles from arid and semi-arid regions of northwest or north China. Many studies have referred Sr isotope composition of loess in Central Loess Plateau (CLP) as a representative of Asian dust. However, Rb-Sr isotope composition of atmospheric aerosols collected over Japan cannot be explained by the mixing relationship between local aerosols and reported Chinese loess. This discrepancy indicates that main source of Asian dust transported to Japan is not originated form CLP, but some other arid and semi-arid regions, such as Inner Mongolia in China or Mongolia. Meteorological data analysed by SYNOP also shows the dust-storm events often occurred in Mongolia and Inner Mongolia. Thus we suggest that Asian dust affected to Japan is mainly originated around southern parts of Mongolia and/or northern parts of China and its Sr isotopic feature is distinctly different from loess of CLP. Unfortunately, the Sr isotope data in inland Asia is very scarce so far. To increase the possibility for source identification, we need the Sr isotope data accumulation.

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How are pristine noble gas signatures of the Earth's interior affected by secondary processes?

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Pristine noble gas signatures in the Earth's interior are often disturbed due to the secondary effects of deep and/or shallow origins, which might be the major causes to confuse the interpretation.

It has been argued that the apparent difference in the He abundance between MORB and OIB shows an inverse trend as expected from their $^{3}He/^{4}He$ isotope systematic, which is called as "the He paradoxes" (Anderson, 1998). However, based on the $^{4}He/^{21}Ne^{*}$ and the $^{4}He/^{40}Ar^{*}$, we can identify that the MORB magmas should have been more enriched in lighter noble gases during magma forming and transporting processes compared to those of OIB. The thickness of OIB glass seems to be systematically thinner than MORB glass (Kaneoka et al., 2002), which might cause less retentive character of noble gases for OIB glass. Different conditions for sampling also affect the observed abundance. Thus, the He paradoxes do not mean a real one about the magma sources, but would be only caused by integrated effects of secondary processes.

As an evidence for recycled Ar, the apparent correlation between the $^{40}Ar/^{36}Ar$ and the $^{206}Pb/^{204}Pb$ for MORB glasses has been raised (Sarda *et al.*, 1999). However, incorporation of fine sediments into an erupting MORB magma is also possible to cause a decrease of the $^{40}Ar/^{36}Ar$ to the atmospheric value (Kumagai and Kaneoka, 1998), which would also increase the value of the $^{206}Pb/^{204}Pb$. Seawater contamination easily decreases the $^{40}Ar/^{36}Ar$, which is often observed in oceanic basalts. Furthermore, the variable $^{3}He/^{4}He$ for recent samples from the same area implies the effect of lithospheric components at shallow depths as observed for Loihi samples.

On the other hand, mantle xenoliths with the high $^{40}Ar/^{36}Ar$ and the atmospheric $^{129}Xe/^{130}Xe$ would indicate the recycled Ar and Xe in the mantle (Kaneoka, 1998). The $^{3}He/^{4}He$ lower than the atmospheric value in mantle xenoliths from the continental margin might also suggest the effect of subducted components. Thus, secondary effects of deep and/or shallow origins occur quite commonly.

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